**Course Competency**

**Competency 1:** The student will learn the history and the scope of Microbiology, the contribution of various scientists to the different branches of Microbiology, and the contribution of microorganisms to our environment and natural processes by:

1. Summarizing the history of the development of Microbiology and the contribution of various pioneers in microbiology and disease prevention.
2. Describing the relevant characteristics of each of the five groups of microorganisms.
3. Explaining the two opposing theories of the origin of Microorganisms:
   - Spontaneous Generation
   - Biogenesis.
4. Explaining the Germ Theory of Disease.
5. Understanding the roles played by microorganisms on Earth.

**Competency 2:** The student will learn the role of microscopy and staining in the study of microorganisms by:

1. Explaining the function of the major parts of the microscope.
2. Discussing magnification, and resolving power of microscopes.
3. Comparing the different types of microscopy.
4. Discussing the procedure and significance of the Gram stain.
5. Contrasting simple, differential and special staining techniques.

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<th>Learning Outcomes</th>
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<td>• Critical thinking</td>
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<td>• Environmental Responsibility</td>
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### Competency 3: The student will learn the structure and functional characteristics of prokaryotic cells by:

- Critical thinking

1. Comparing prokaryotic and eukaryotic cells.
2. Describing structures of prokaryotic cells.
3. Describing the endosymbiotic theory of the origin of mitochondria and chloroplasts.
4. Describing the formation, function and significance of endospores.
5. Explaining various mechanisms for transport of molecules across the plasma membrane, and group translocation.
6. Discussing the effects of osmosis on microbial control.
7. Contrasting the structures of the cell wall of Gram-positive, Gram-negative and Acid-Fast cells and their effect on differential staining.
8. Describing the structure and function of the prokaryotic flagellum.
9. Understanding the role of cellular structures in the formation of microbial communities and biofilms.

### Competency 4: The student will learn taxonomy and classification of microorganisms by:

- Numbers / Data
- Critical thinking

1. Discussing taxonomy, taxa and phylogeny.
2. Discussing the advantages of the three-domain system over other traditional methods to assess the phylogenetic relatedness among microorganisms.
3. Defining binomial nomenclature.
4. Comparing methods used in classifying and identifying microorganisms.
5. Contrasting cladograms and dichotomous keys.

### Competency 5: The student will summarize distinct structural and physiological characteristics of the major groups of prokaryotic and eukaryotic microorganisms by:

- Critical thinking
1. Comparing features common to microbes in the domain Archaea, domain Bacteria and domain Eukarya.
2. Discussing the major groups of Bacteria.
3. Describing the major groups of Archaea.
4. Comparing the major groups of Fungi and Protists.
5. Listing the major groups of eukaryotic parasites.

**Competency 6:** The student will learn the importance and complexity of metabolic reactions in microorganisms by:

- Numbers / Data
- Critical thinking
- Computer / Technology Usage

1. Discussing the role of ATP in anabolism and catabolism.
2. Discussing the role of enzymes in biochemical reactions and metabolic pathways.
3. Discussing factors that affect enzyme activity.
4. Defining oxidation, reduction and dehydrogenation reactions in biological systems.
5. Contrasting the three types of phosphorylation reactions generating ATP.
6. Discussing the three stages of glucose catabolism and the production of ATP.
7. Discussing the fate of the carbon atoms in a molecule of glucose during aerobic respiration.
8. Listing the types of electron carriers in electron transport chains.
9. Describing the role of chemiosmosis in oxidative phosphorylation of ATP.
10. Listing types of fermentation used by microorganisms and the chemical reactions involved.
11. Contrasting aerobic and anaerobic respiration and fermentation in terms of final electron acceptor and ATP production.
12. Describing the use of carbohydrate fermentation as biochemical tests for the identification of bacteria in clinical specimens.
13. Describing how lipids and proteins are catabolized.
15. Discussing the importance of amphibolic pathways in linking catabolism and anabolism.

**Course Competency 7:** The student will learn the dynamics of microbial growth by:

- Numbers / Data
- Critical thinking
- Computer / Technology Usage

1. Describing the chemical and physical requirements for microbial growth and reproduction.
2. Describing and differentiating organisms based on their oxygen requirements.
3. Discussing the different toxic forms of oxygen and explaining how organisms protect themselves from toxic forms of oxygen.
4. Comparing the different pure culture techniques.
5. Comparing the types of culture media and methods available to establish cultures and preserving of microorganisms.
6. Explaining the bacterial growth curve.

**Course Competency 8:** The student will learn principles of controlling microbial growth, and physiology by:

- Numbers / Data
- Critical thinking
- Information Literacy

1. Differentiating between antisepsis, disinfection, and sterilization.
2. Discussing the factors affecting the efficacy of antimicrobial control methods.
3. Contrasting the methods used for the evaluation of disinfectants and antiseptics.
4. Explaining the mode of action of antimicrobial agents used for control of microbes in the environment.
5. Comparing the physical methods of microbial control.
7. Explaining the mechanisms of action antimicrobial chemotherapeutic agents used for infectious diseases.
8. Distinguishing between narrow- and broad-spectrum chemotherapeutic agents.
9. Comparing Kirby-Bauer, E-test, minimal inhibitory concentration (MIC), and minimal bactericidal concentration (MBC) tests.
10. Discussing the clinical considerations in prescribing antimicrobial drugs.
11. Discussing mechanisms of drug resistance and how it can be prevented.

**Course Competency 9:** The student will learn the flow and control of genetic information within and between cells by:

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<tbody>
<tr>
<td>1. Describing the structure, function, and replication of DNA.</td>
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<td>2. Explaining how the genotype of an organism determines its phenotype.</td>
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<td>3. Describing the central dogma of genetics and explaining the roles of DNA and RNA in polypeptide synthesis.</td>
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<td>4. Explaining the operon model of transcriptional control in prokaryotes.</td>
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<td>5. Defining mutation and discussing different types of mutations.</td>
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<td>6. Discussing how different types of mutagenic agents increase mutation frequencies.</td>
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<td>7. Describing chemical mutagens and their effects on cells.</td>
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<td>8. Contrasting the positive and negative selection techniques for isolating mutants.</td>
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<td>10. Comparing various DNA repair mechanisms.</td>
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<td>12. Contrasting vertical with horizontal gene transfer mechanisms in bacteria.</td>
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<td>13. Explaining how gene transfer in bacteria contributes to antibiotic resistance.</td>
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<tr>
<td>14. Describing the structures and actions of simple and complex transposons.</td>
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<td>15. Explaining how gene transfer mediated by transposons contributes to antibiotic resistance.</td>
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- Numbers / Data
- Critical thinking
- Computer / Technology Usage
**Course Competency 10:** The student will demonstrate knowledge of the principles of recombinant DNA technology by:

1. Describing the structure and function of plasmids, and their role in recombinant DNA technology.
2. Describing common tools and techniques used in Biotechnology.
3. Describing the Polymerase Chain Reaction (PCR) and the various contributions of PCR to the field of microbiology.
4. Listing various application of recombinant technology.
5. Discussing the safety and ethical concerns regarding gene manipulation using recombinant DNA technology.

**Course Competency 11:** The student will learn the structure and function of acellular microbes such as viruses, viroids, and prions by:

1. Describing the general structural and morphological characteristics of viruses.
2. Listing the various methods for culturing and propagating viruses.
3. Discussing the lytic and lysogenic replication cycles of bacteriophages.
4. Describing the various strategies for viral genome replication.
5. Comparing bacteriophage and animal virus genome replication strategies.
6. Defining the process of budding and its relationship to enveloped viruses.
7. Defining latent and persistent viral infections.
8. Discussing oncoviruses and their relationship to cancer.
9. Discussing the mechanisms by which Prions cause diseases.
10. Contrasting viroids, prions and viruses.

**Course Competency 12:** The student will learn the pathogenic mechanisms of microorganisms and their roles in infectious disease by:

- Numbers / Data
- Critical thinking
- Computer / Technology Usage
- Environmental Responsibility

**Updated Summer 2021**
1. Discussing the various portals of entry and exit for infectious microbes.
2. Defining Infectious dose (ID50) and Lethal dose (LD50).
3. Describing pathogenic mechanisms in bacteria and viruses that damage host cells.

**Course Competency 13:** The student will learn the principles of disease and epidemiology by:

- Environmental Responsibility
- Numbers / Data
- Critical thinking

1. Defining infection and disease.
2. Describing normal and transient microbiota.
3. Explaining symbiotic relationships between microbiota and their hosts.
4. Listing Koch’s postulates and their limitations.
5. Differentiating the types of infectious diseases.
7. Listing reservoirs and methods of transmission of infectious microbes.
8. Discussing hospital-acquired infections (HAI) and their control.
10. Discussing the applications of Epidemiology.

**Course Competency 14:** The student will learn the host defense mechanisms against infectious diseases by:

- Critical thinking

1. Describing the non-specific defense mechanisms in the human body.
2. Contrasting innate versus adaptive immunity.
3. Discussing the mechanism employed by pathogens to evade and or survive phagocytosis.
4. Explaining the components and consequences of complement activation.
5. Comparing active versus passive immunity and natural acquired versus artificially acquired immunity.
6. Differentiating the components of Humoral versus cellular immunity.
7. Discussing five classes of antibodies and their functions.
8. Describing the various classes of T cells and their functions.
| 9. Discussing different types of hypersensitivity reactions. |   |